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GB 1539649 A EP 0052685 A1 WO 90/16045 A1

WO 83/00780 A1 US 4878107 A US 4495651 A

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(54) Capacitance proximity switch controlled apparatus

(57) Electric motor driven equipment designed for use by a physically handicapped person is controlled by capacitance proximity switches. The switches are preferably arranged with four switches in a ring (figure 2 not shown) in a waterproof housing with the switches located on the rear of a printed circuit board. Lamps, which are alight in a stand-by condition of the equipment, and/or sound emitters which emit sound upon operation of the switches, may be associated with the switches.

To reduce the risk of false switching, the switches may include circuitry including a signal treating means the output power of which is reduced as a human body approaches the switch. This signal treating means may be realised by a virtual earth amplifier A1 having a feedback impedance Z2 in a circuit including an oscillator, the switch capacitor Z1, the signal treating means, a high pass filter, a rectifier and a comparator.

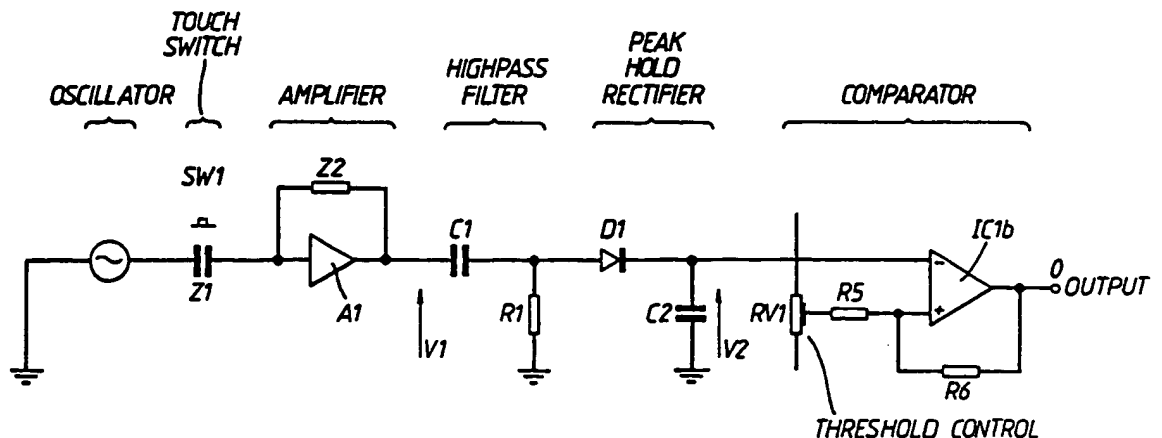


Fig.3.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1990.

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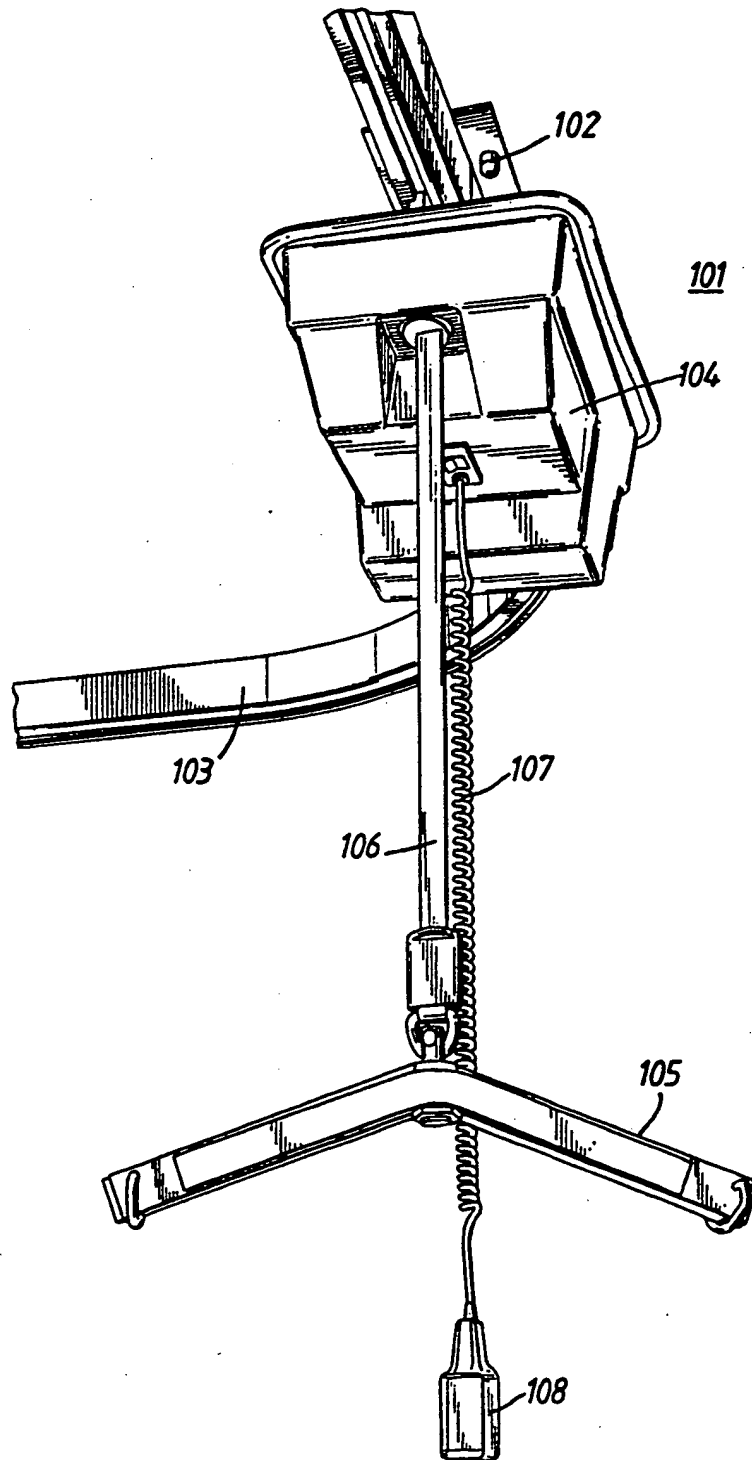


Fig.1.

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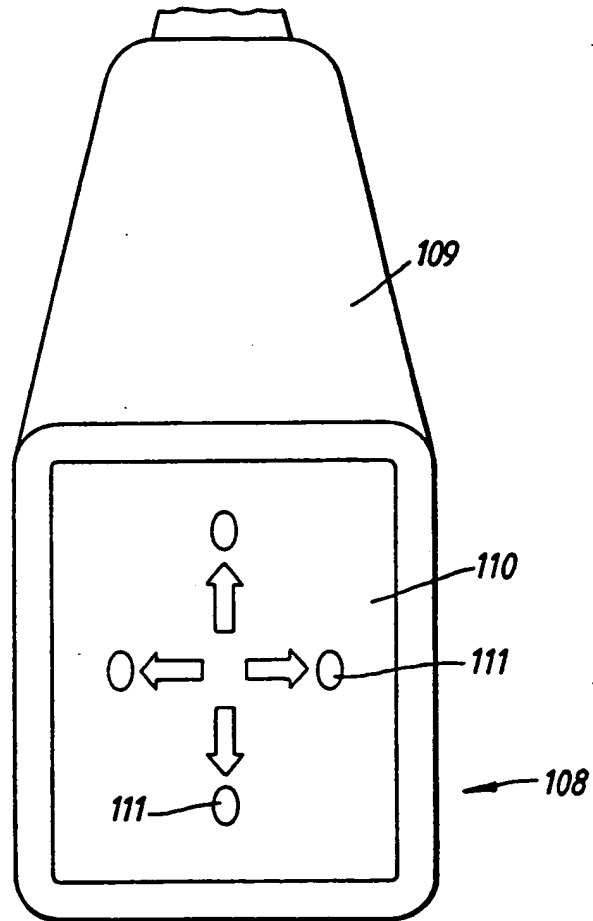


Fig.2.

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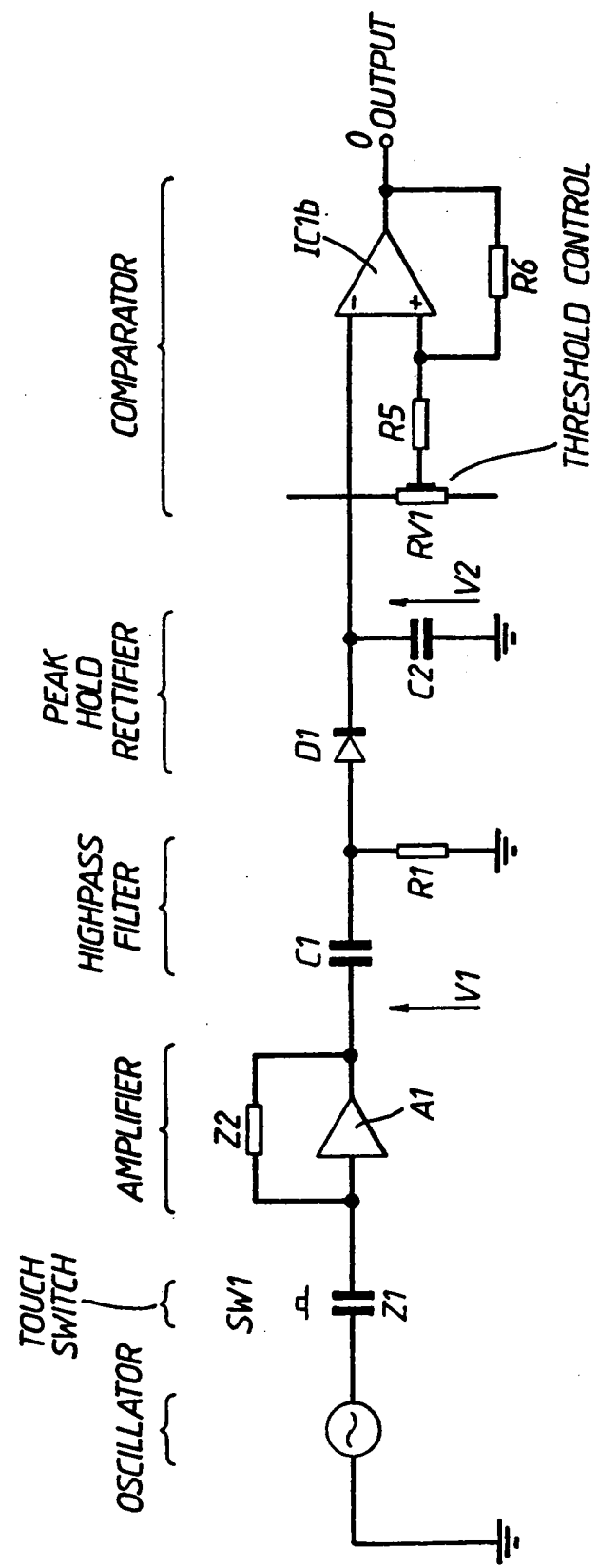


Fig.3.

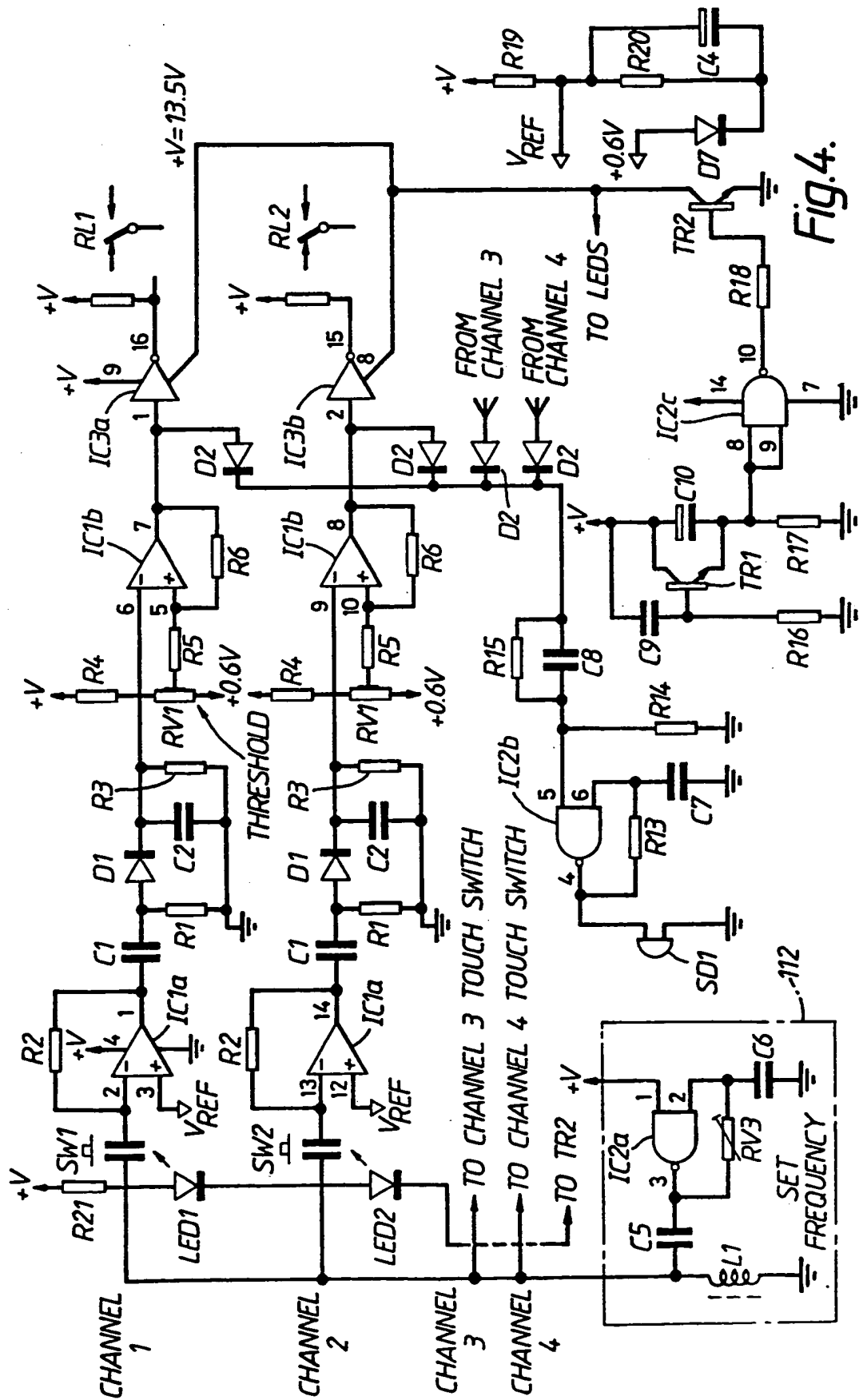


Fig. 4.

"EQUIPMENT"

This invention relates to equipment particularly designed for use by the physically handicapped.

5 It is known to control motive units of handicapped equipment, such as ceiling hoists, wheelchairs, electrically operated beds, electrical mobile lifters, electrically operated bath lifts and recliner and/or lift-out chairs, by means of electro-mechanical switches. These switches include press-buttons or switch arms which have to be
10 manually operated against the action of a return spring and may thereafter need to be held in the operating position against the action of that spring. Some handicapped people, for example those with muscular dystrophy, sometimes have an inability to maintain a significant force, or even
15 to apply a significant force. Such people have difficulties in operating the electro-mechanical switches and particularly in maintaining such switches in their operating positions. Some handicapped people also suffer from poor hearing, poor sight or senility. Handicapped people,
20 especially those with poor sight or those operating switches in darkness, often rely on sound to inform them that an electro-mechanical switch has been operated by them. Those with poor hearing have difficulty knowing whether they have operated electro-mechanical switches in darkness.

25 These electro-mechanical switches also have the disadvantage that, if they are dropped in water. they are prone to suffer ingress of moisture and consequential damage.

30 According to one aspect of the present invention, there is provided equipment particularly designed for use by the physically handicapped, comprising an electrically actuated device for performing a function, and electrical proximity switching circuitry connected to said device for actuating said device, said circuitry including capacitance means
35 variable by the approach of a part of the human body.

An advantage of the invention is that the proximity

switching arrangement does not require the application or sustaining of force by the user. Another advantage is that the switching arrangement can be protected against ingress of moisture relatively easily and thus cheaply.

5 According to a second aspect of the present invention, there is provided equipment particularly designed for use by the physically handicapped, comprising a device for performing a function, switching means connected to said device for actuating said device, and light-emitting means
10 associated with said switching means and arranged to emit visible light in a stand-by condition of said equipment.

 An advantage of this arrangement is that a handicapped person with poor sight or in darkness can direct a finger (or other operating part of the body) to the light-emitting
15 means to operate the switching means.

 According to a third aspect of the present invention, there is provided equipment particularly designed for use by the physically handicapped, comprising a device for performing a function, electronic switching means connected
20 to said device for actuating said device, and sound-emitting means associated with said switching means and arranged to emit audible sound upon operation of said switching means.

 This arrangement has the advantage that a handicapped person with poor sight or in darkness is informed by sound
25 of his operation of the switching means.

 According to a fourth aspect of the present invention, there is provided electrical proximity switching circuitry comprising power supply means, capacitance means connected to the output of said power supply means and variable by the
30 approach of a part of the human body, signal treating means connected to the output of said capacitance means for treating an output signal from said capacitance means, and control means connected to the output of said signal treating means for actuating an electrically actuatable
35 device, the arrangement being such that the approach of said part to said capacitance means reduces the output power of

said signal treating means and causes said control means to actuate said device.

5 This arrangement has the advantage of preventing unwanted signals induced in the capacitance means by interference from causing false actuation of the device by the control means.

10 In order that the invention may be clearly understood and readily carried into effect, reference will now be made, by a way of example, to the accompanying drawings, in which:-

Fig.1 shows an underneath perspective view of a ceiling hoist particularly designed for use by the physically handicapped,

15 Fig.2 shows a front elevation of a hand-held control unit of the hoist,

Fig.3 shows a simplified, electrical circuit diagram of one of four identical electronic proximity switching channels of the hoist, and

20 Fig.4 is an electrical circuit diagram of proximity switching circuitry of the hoist including two of the channels shown in detail.

Referring to Fig.1, there is attached to a ceiling 101 by way of brackets 102 a track 103 upon which is mounted a travelling hoist 104 including a spreader bar 105 mounted upon a winding belt 106 whereby the spreader bar 105 is vertically displaceable. Suspended by an extensible lead 107 is a hand-held control unit 108 operable either by a patient suspended in a sling (not shown) from the spreader bar 105 or by a helper.

30 The Unit 108 is shown in more detail in Fig.2 and includes a waterproof housing 109 formed with an aperture closed by a printed circuit board coated externally with a transparent plastics film 110. The printed circuit board is of glass fibre and is opaque except at four locations 111 at which are four illuminated switches (SW1, etc. in Figures 3 and 4) which, as indicated by the arrows, are operable to

35

raise or lower the spreader bar 105 or to cause the hoist 104 to travel to or fro along the track 103.

One face of the printed circuit board is copper clad, the non-copper face being coated with the thin plastics film 110 and facing the user. A copper track is arranged to form, for each switch SW1 etc., a capacitor consisting of two concentric circles. Normally, the electrical value of the capacitor is determined by the geometry of the copper track and the dielectric properties of the surroundings, such as the glass fibre printed circuit board and surrounding air. When a user's finger approaches the switch, the dielectric properties of the switch change so as to cause a small reduction in capacitance. So that the unit 108 is user-friendly, it is advantageous if the user believes that he has to touch the film 110 for the switch to operate.

Fig. 3 shows, in outline form, the main circuit blocks of switching channel 1. A high frequency alternating voltage is applied to one of the switch capacitor plates while the other is connected to the input of a virtual earth amplifier A1 having a feed-back impedance Z2. The voltage gain of the amplifier A1 is equal to Z2 divided by Z1 (Z1 is the impedance of the switch capacitor, while Z2 is equal to a fixed value of resistor).

The resulting output voltage V1 assumes a value determined by the values of these components. When the switch SW1 is activated, the reduction of switch capacitance results in Z1 increasing, so reducing output voltage V1.

The output voltage V1 is applied to a high pass filter C1/R1 which is included to reduce the effects of power line interference. A peak hold rectifier circuit D1/C2 follows which applies the resulting dc voltage V2 to the input of an amplifier IC1b configured as a voltage comparator. The output O of this comparator is either high or low depending on the relative values of the dc voltage V2 and the setting of a threshold control RV1.

When the switch SW1 is de-activated, the output O of

th comparator is low, th inverting input (-) being higher than the non-inverting input (+). When the switch SW1 is activated, the output 0 goes high and is used to drive further control circuitry.

5 A feature of this circuit is that under normal conditions the output voltage V1 of the amplifier A1 is high and falls only when the switch SW1 is actuated. This prevents false operation due to unwanted signals being induced in the high impedance (sensitive) parts, particularly Z1, of the circuit since these signals would
10 only increase the output voltage V1.

Inversion takes place further on in the signal path where the impedances are low and thus less affected by interference signals.

15 Fig. 4 shows in detail two channels 1 and 2 of a four-channel system; channels 3 and 4 are identical to 1 and 2, but have been omitted for clarity. The circuit has been designed so that relays RL1/2 etc. control the motors of the hoist 104.

20 Channel 1 will now be described. The switch SW1 is illuminated by LED1. The output of a 60kHz RC oscillator 112 is applied to one plate of the switch capacitor SW1. The RC oscillator 112 is formed from one gate of a NAND Schmitt trigger IC2a, the resulting square wave output of
25 which is fed to the tuned circuit L1/C5. Variable resistor RV3 is included to optimise the symmetry of the output waveform. The oscillator output is coupled via the switch SW1 to the virtual earth input of the amplifier A1 in the form of an integrated circuit IC1a, the gain being
30 determined by the value of the resistor R2. The output is fed to a high pass filter C1/R1, the ac output of which is rectified and smoothed by D1/C2 and fed to a comparator IC1b. When the switch SW1 is de-activated, the comparator output is normally low. The threshold control RV1 is
35 adjusted to cause the output at pin 7 to go high when the switch SW1 is activated. Hysteresis is achieved by the

inclusion of the resistors R5/R6. The comparator output is fed to relay driver IC3a. Suppression of inductive spikes when RL1 is actuated is achieved by an internal diode in IC3a.

5 When the switch of any channel is activated, the comparator output is fed via D2 and C8 to one input of NAND gate IC2b; this momentarily causes the oscillator formed by the components IC2b, C7 and R13 to start and drive a piezo sounder SD1. When power is applied, the relay drivers and
10 LEDs are prevented by a short duration timer from operating until the circuit conditions have stabilised, the timing period being determined by C10/R17. NAND gate IC2c is connected as an inverter, its output feeding switching transistor TR2 which is turned on at the end of the timer
15 interval. TR1 and associated components are included to ensure that the timer resets at power up. Diode D7 is included to give some measure of temperature compensation

The proximity switching system described with reference to Figures 3 and 4 has the following important features:-

- 20 1. No manual force is required to operate the switch.
2. The audible sounder SD1 and the hysteresis given by the positive feedback provided by the resistors R5 and R6 simulate the action of a mechanical switch, namely its clicking sound and its characteristic that its
25 actuating point is closer to the control unit than its de-actuating point, insofar as the user's finger is concerned.
3. Its electronic circuitry minimises the risk of false operation due to power line magnetic or electric fields or radio frequency interference.
30 4. If the control unit 108 were to be dropped in water, for example into a bath, although all four switches SW1 to SW4 would be likely to be operated, the mutually opposing motive effect so produced would mean that the
35 patient would remain stationary and the control electronics prevented from suffering consequential

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damage.

5 The audible sounder of the proximity switching system
may b such as to emit a variety of sounds, such as a
variety of pitches, depending upon which switch is being
operated by the user, so that the user can know which switch
he has operated.

CLAIMS

1. Equipment particularly designed for use by the physically handicapped, comprising an electrically actuated device for performing a function, and electrical proximity switching circuitry connected to said device for actuating said device, said circuitry including capacitance means variable by the approach of a part of the human body.
2. Equipment according to claim 1, wherein said circuitry includes switching means contained in a waterproof housing.
3. Equipment according to claim 1 or 2, wherein said switching means includes four switches arranged in a ring.
4. Equipment according to claim 2 or 3, wherein said switching means is provided on a printed major face of a printed circuit board, the opposite face of which is directed outwardly.
5. Equipment according to any preceding claim, and further comprising light-emitting means associated with said switching circuitry and arranged to emit visible light in a stand-by condition of said equipment.
6. Equipment according to any preceding claim and further comprising sound-emitting means associated with said switching circuitry and arranged to emit audible sound upon operation of said switching circuitry.
7. Equipment according to any preceding claim, wherein said circuitry comprises power supply means to the output of which said capacitance means is connected, signal treating means connected to the output of said capacitance means for treating an output signal from said capacitance means, and control means connected to the output of said signal treating means for actuating said device, the arrangement being such that the approach of said part to said capacitance means reduces the output power of said signal treating means and causes said control means to actuate said device.
8. Equipment according to claim 7, wherein said signal

treating means comprises a virtual earth amplifier having a feed-back impedance.

5 9. Equipment particularly designed for use by the physically handicapped, comprising a device for performing a function, switching means connected to said device for actuating said device, and light-emitting means associated with said switching means and arranged to emit visible light in a stand-by condition of said equipment.

10 10. Equipment particularly designed for use by the physically handicapped, comprising a device for performing a function, electronic switching means connected to said device for actuating said device, and sound-emitting means associated with said switching means and arranged to emit audible sound upon operation of said switching means.

15 11. Electrical proximity switching circuitry comprising power supply means, capacitance means connected to the output of said power supply means and variable by the approach of a part of the human body, signal treating means connected to the output of said capacitance means for
20 treating an output signal from said capacitance means, and control means connected to the output of said signal treating means for actuating an electrically actuatable device, the arrangement being such that the approach of said part to said capacitance means reduces the output power of
25 said signal treating means and causes said control means to actuate said device.

12. Equipment particularly designed for use by the physically handicapped, substantially as hereinbefore described with reference to the accompanying drawings.

30 13. Electrical proximity switching circuitry, substantially as hereinbefore described with reference to Fig.3 of the accompanying drawings.

Pat nts Act 1977
Examiner's report to the Comptroller under
Section 17 (The Search Report)

- 10 -

Application number

GB 9120629.2

Relevant Technical fields

(i) UK Cl (Edition K) G1N PART D

(ii) Int Cl (Edition 5) H03K

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Search Examiner

D J MOBBS

Date of Search

1 DECEMBER 1992

Documents considered relevant following a search in respect of claims 1-8, 12, 13

| Category (see over) | Identity of document and relevant passages | Relevant claim(s) |
|------------------------|---|----------------------|
| X Y | GB 1539649 (GEC) | 1, 2, 4 |
| X Y | EP 0052685 A1 (STARCOTE) see particularly figure 3 and pages 8-9 | 1, 7 |
| X Y | WO 90/16045 A1 (TAIT) see particularly Figure 1F | 1, 3 |
| Y | WO 83/00780 A1 (ELECTRICAL EQUIPMENT) | 1, 5 |
| X Y | US 4878107 (HOPPER) see particularly column 3 lines 8-22 and Claim 1 | 1, 5 |
| X | US 4495651 (FROELIGER) see particularly column 6 line 49 to column 7 line 5 | 1, 2, 4, 5 6, 7 |
| Y | US 4290052 (EICHE LBERGER) see particularly column 2 lines 14-40 | 1, 2, 4 |

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SF2(p)

| Category | Identity of document and relevant passages | Relevant to claim(s). |
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